NASA Facts

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

AC 301 286-8955

FS-2000-3-003-GSFC

NASA to Launch First of a New Generation of Tracking and Data Relay Satellites

NASA is poised to launch the first of three new communications satellites, which will serve the Space Shuttle, International Space Station, Hubble Space Telescope and other Earth-orbiting satellites with improved communications and data relay services well into the 21st century.

Called the Tracking and Data Relay Satellite-H, or TDRS-H, this second generation satellite is scheduled to launch in the summer of 2000 aboard an Atlas IIA rocket from Cape Canaveral Air Force Station, Fla. TDRS-I and -J are scheduled to launch in 2002 and 2003 respectively. The new trio of satellites will help replenish the current TDRS constellation, which has provided communication services to the Space Shuttle and other orbiting spacecraft since 1983.

Artist concept of TDRS-H spacecraft on orbit.

The new series of satellites will not only increase communications, but also maintain compatibility with the on-orbit TDRS fleet.

Similar to other communications satellites, TDRS-H will be deployed into a 22,300 mile high “geosynchronous” orbit, maintaining a fixed position above the Earth. A TDRS is unique, however, in it’s ability to follow the motion of fast moving satellites, providing nearly continuous communication links with controllers and researchers back on the ground.

Satellite Capabilities

The new data and relay satellites retain and augment two large antennas that move smoothly to track satellites orbiting below, providing high data rate communications. Another new feature is the higher radio-frequency communications band.

The “Ka-band” will enable higher data rates at a more favorable band,and are less susceptible to interference from the increasingly busy radio environment. The new band has been coordinated with planned Japanese and European relay systems to permit a greater extent of mutual support and possible fallback operations.

TDRS-H, -I and -J also include an improved “Multiple-Access” system. This system operates at the 2,200 gigahertz (Ghz) band and is capable of supporting five additional users at higher rates than the original TDRS fleet.

The communications services offered by TDRS-H, -I and -J are summarized below:

S-Band Single Access : Provided by two 15-foot diameter steerable antennas that are used at the 2,200 GHz band to provide robust communications to satellites with a small antenna, or to communicate with launch vehicles during launch.

Ku-Band Single Access - The same two large antennas also operate at a higher bandwidth to provide the planned International Space Station with high-resolution digital television, or to dump large volumes of data at rates up to 300 megabits per second (Mbps), which roughly equates to moving the contents of 26 full computer diskettes per second.

Ka-Band Single Access - This new higher-frequency service, provides tunable wideband channels that will permit up to 800 Mbps for future missions.

Multiple Access - The S-band phased array antenna can support five lower data rate users in the space-to-Earth direction (for returning data collected in space) and one user each time in the Earth-to-space direction (used to command and control user satellites.)

Satellite Navigation - In addition to equipment located at the White Sands (New Mexico) ground terminal, the system will continue to provide user navigational data required to find the orbit and position of NASA user satellites.

New Antenna Design for Ka-band

A pair of 15-foot diameter reflectors, made of a flexible graphite mesh were

developed to provide the large, accurate and steerable antennas needed at the Ka-band operating frequencies. The reflectors' composite material permitted an economical fabrication that allows them to fold easily, conforming to the limited space inside the launch vehicle.

The spacecraft is launched with its antennas folded into a taco-like shape. Upon reaching orbit, stowage straps are released, unfurling the antennas and allowing them to spring back to their original shape. Each antenana uses mechanical adjustments that tune them on orbit into a precise shape.

Acquisition Approach

NASA contracted with Hughes Space and Communications of El Segundo, Calif. for the new trio of tracking and data relay satellites. A new procurement approach, which substitutes higher-level performance specifications in lieu of detailed technical specifications, allowed the contractor to use commercial practices to build the satellites at a reduced cost.

With NASA's greater emphasis on contractor accountability, the contract includes a unique payback provision that will protect the Agency's interests should a service failure occur during the first eight years of the spacecraft's 11-year design lifetime.

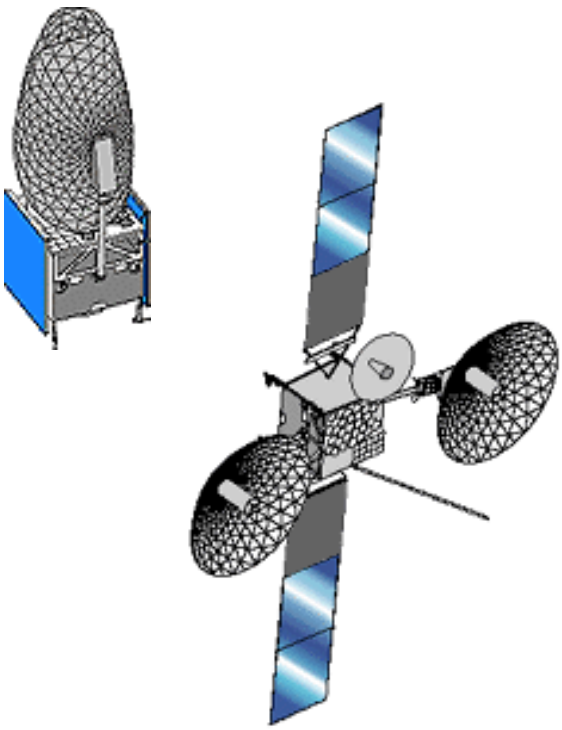
System Background

The current Tracking and Data Relay Satellite System, or TDRSS, consists of the six original tracking and data relay satellites, which were built by TRW of Redondo Beach, Calif., a ground complex in White Sands, N.M., a ground terminal extension on the island of Guam in the South Pacific, customer scheduling and data handling facilities.

Goddard Space Flight Center in Greenbelt, Md. manages the TDRSS by using tracking and data relay satellites that are located at 41, 46, 171, 174 and 275 degrees west longitude.

NASA removed TDRS-1 from its 49 degrees west longitude location so that it could provide part-time coverage of the Antarctic region in support of research efforts conducted by the National Science Foundation.

From its high altitude perch, the sys-



TDRS-H shown on left with antennas stowed in a folded position before launch. On right, the antennas fully deploy on orbit. (Artist concept courtesy of Hughes)

tem has the ability to maintain near continuous contacts with lower satellites, replacing dozens of ground stations which used to be required to maintain minimal contact with the Space Shuttle and other Earth orbiting satellites.

The outstanding success of TDRSS in improving space flight communications has, in some respects, masked other far-reaching achievements of the system, such as communications required for state-of-the-art commercial applications, launch vehicle telemetry and government system acquisition.

These achievements include:

• *Flight Operations*: An extensive and costly ground-based tracking system, which relied on foreign sites, numerous personnel, tracking vessels and aircraft that, in the aggregate, provided users less than 15 percent contact each orbit, was replaced with NASA's TDRSS. Users now benefit from nearly-continuous contact, higher data rates and accurate navigation information.

• *Multiple Users:* The TDRSS pioneered simultaneous support to multiple diverse space users by shared space and ground assets and by employing advanced communications technologies and scheduling operations.

• *Innovative acquisition:* The TDRSS was a trailblazer of commercial/government dual use of spacecraft, of lease and purchase procurement and of hosting a commercial communications package.

• *Launch Operations:* With its unique capability to view and track a launch from anywhere on Earth, the TDRSS is providing increased support for new classes of launch vehicles. The additional support provides much better coverage at lower cost.

• *Communications Research:* The TDRSS has been a test platform for a plethora of research trials such as radio-frequency propagation, very-long-base interferometry, digital radio broadcasting, telemedicine and aircraft satellite communications, which serve to advance civilian mobile and military communications.

• *Ancillary Applications:* Residual TDRSS assets (e.g., TDRS-1) have provided terrestrial communications for researchers located at remote areas such as the South Pole.

Working in conjunction with the TDRSS, NASA's trio of replenishment satellites will provide vital communication links to a rapidly growing fleet of research aircraft, satellites and government and commercial launch vehicles during the next decade and possibly longer.

Websites

For more information about the TDRS-H, -I and -J spacecraft, go to:
http://tdrs.gsfc.nasa.gov/Tdrsproject/

For additional information about TDRSS, go to:
http://nmsp.gsfc.nasa.gov/tdrss/